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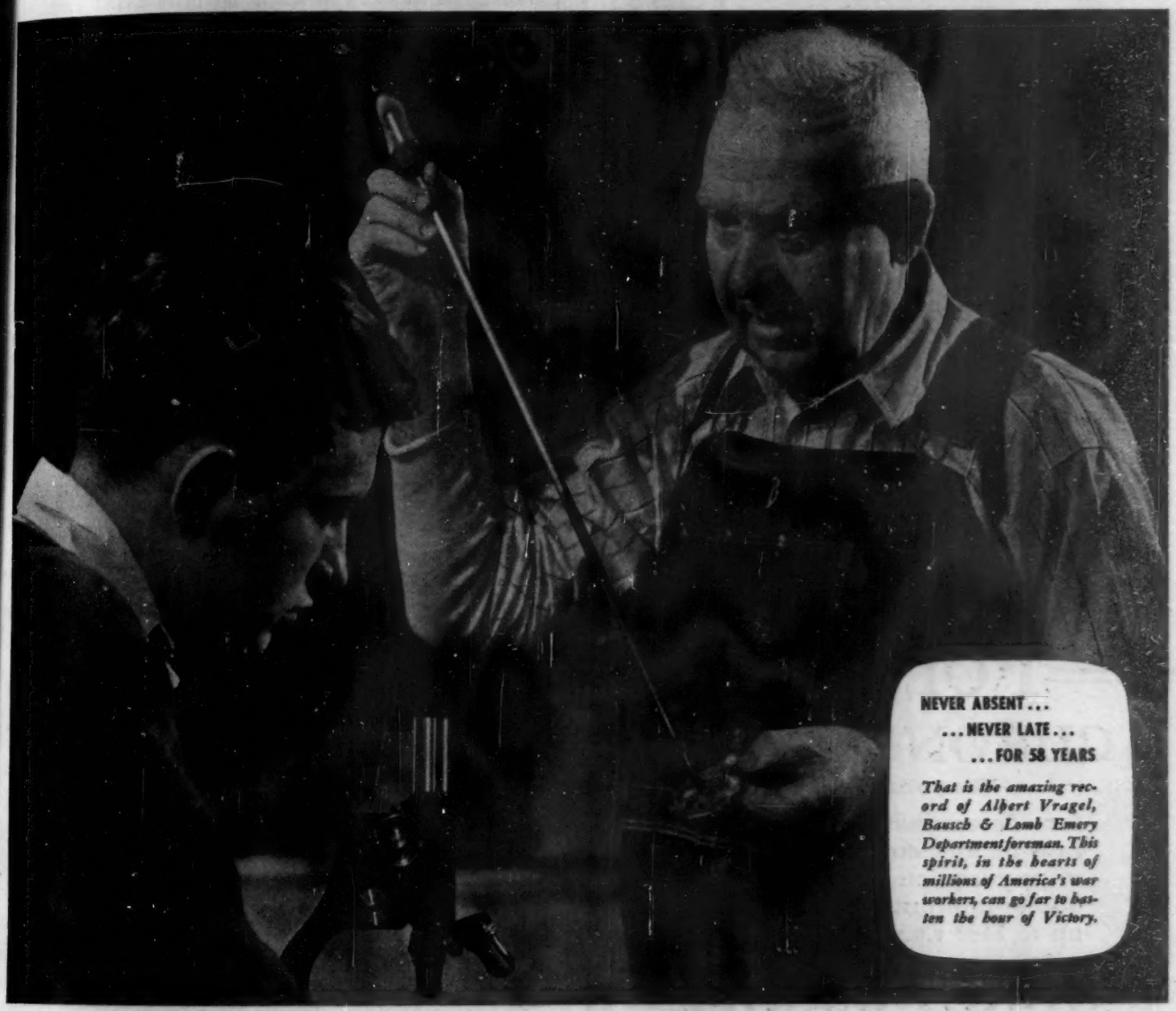
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INDUSTRIAL SCIENCE LOOKS AHEAD[1]

By DAVID SARNOFF

PRESIDENT, RADIO CORPORATION OF AMERICA

INDUSTRIAL science at war is shaping a new world. While the battlelines of the United Nations encircle the Fortress Europe and the pincers of Victory tighten on the enemy in the Pacific, civilization advances ever closer to the post-war horizon. With Victory will come the day when the scientific instruments and processes of war will turn abruptly to peace. Machines and tools, as well as industrial and economic thinking, will be converted quickly from the demands of war to the needs of peace. Industry will be called upon to relieve the strains of war with utmost speed by ministering anew to human welfare, health and comfort. Already post-war planners are at work in many fields of industrial endeavor.

But it is not new for American industry to be surveying and planning for the future. That process is always at work here, whether the world is at peace or at war. Only by advanced thinking, research, engineering and continual pioneering, can industrial science put new ideas into action. By doing this, industry serves its workers and the people, and thereby wins the right to survive.

We have but to consider some of the outstanding wartime developments of industrial science to realize their widespread applications in all fields; from automobiles to giant turbines and diesel engines, from cameras to facsimile and television. Endlessly, these advances extend into every realm of our daily lives. Among the promises of better living we are told of new plastics, light metals, synthetic textiles, high-octane gasoline, artificial rubber, luminescent lighting, air-conditioning, dehydration of foodstuffs and many other innovations. We even hear of glass flatirons and plastic lenses. We are promised revolutionary changes in homes, aircraft, communications, ships, railroads, automobiles, highways, clothing and foods. In myriad ways the wartime inventions in electricity,

[1] Address before the Lancaster Branch of the American Association for the Advancement of Science, delivered at Franklin and Marshall College on November 11, 1943.

metallurgy, chemistry and physics will open new gateways for industrial science to enter and enrich our everyday life.

As for the great, modern art of radio, I can promise you that as a service to mankind everywhere, it will keep pace with the march of science and industry.

To-day is the anniversary of a historic event that provides us with a timely opportunity to review the remarkable advances of radio within a quarter century, to reflect upon its vital role in the war, and to look into its future.

Twenty-five years ago this morning, news flashed across the hemispheres that the first World War had ended. In retrospect that day appears as a fleeting moment. History lifted her pen and paused to dot the "i" of an empty Victory that proved to be only the prelude to a global war unprecendented in fury, extent and destruction.

In that autumn of 1918, Germany's pleas for peace had revealed the plight of the German people. Germany was cracking. American radio was entrusted to transmit to a defeated nation President Wilson's Fourteen Points as a basis for the restoration of peace, and for a general armistice on land, on water and in the air. Radio operators stood by for the answer. It came on the midnight air of November 11, when silence in the "ether" over the Atlantic was interrupted by a flash from Europe. At 2:45 A.M. New York time, the news broke. The State Department in Washington announced the Armistice had been signed at midnight, and hostilities would cease at 6 o'clock in the morning—11 A.M., in France.

There was no radio broadcasting to spread the welcome word—"It's over, over there!"

Under the banner headline "Peace," Americans read the news at their breakfast tables. The world was only a reading world at that time. It had not yet learned to listen. News spread slowly in 1918. Although powerful radio alternators relayed these tidings around the world to ships on the Seven Seas, homes were not yet radio equipped. Many days passed before news of the Armistice filtered into remote hamlets and farms. War correspondents were scribes, not eyewitness broadcasters; they had the pen but no microphone. To-day, news travels at the speed of light, in every language, to every corner of the earth.

In those days there were no globe-encircling short waves, no high-power vacuum tubes, no universal receiving sets. The radiophone was just learning to talk. The electron tube had not yet revealed its power and its unlimited possibilities.

The radio of that day gave everything it had to win the war. Research men and engineers rushed new devices into service to maintain contacts with the battle-fleet, with the convoys and the American Expeditionary Force in France. Although ships in the mid-Atlantic could not maintain direct contact with American and European shores, the long waves of powerful land stations swept across the sea and linked America with its Allies. War bulletins moved through the air at the rate of 30 to 40 words a minute. To-day, short waves and high-speed automatic machines handle news at the rate of more than 600 words a minute. In the first World War, American newspapers had to wait for ships to arrive with the historic pictures of Pershing and the A.E.F. in France. Now radiophoto service can deliver pictures of Eisenhower and his forces in Italy and MacArthur and his troops in the South Pacific a few minutes after the camera snaps them.

To-day, largely because of radio, New York is the communication center of the world. In 1918, it was London. During the first World War the United States found itself at the mercy of foreign communications. America learned the lesson then that radio was the nerve system of war as well as of peace. Immediate steps were taken to safeguard the future, to give the United States supremacy in world-wide communications and to make sure that never again would this Republic be dependent upon the wavelengths, cables or wires operated and controlled by other nations.

As a result of this determination, the direct radiotelegraph circuits of RCA now reach 51 countries in Central and South America, the West Indies, Europe, Asia, Africa and Australasia. Radiophoto circuits operate between New York and London, Stockholm, Berne, Moscow, Cairo and Buenos Aires, while the terminal at San Francisco serves Honolulu and Melbourne.

In this war, radio is everywhere—with soldier, sailor, marine and airman. Modern warfare has put radio instruments into every bomber and fighter plane, into every mechanized unit and into every ship. There were no walkie-talkies or handy-talkies in No-Man's Land, at Verdun or at the Marne. The "cease firing" order signed by Foch was shouted and carried by runners along the trenches. The radio equipment of that day was too massive and too heavy for more than a limited use in airplanes. Now, compact, efficient radio goes aloft with all planes; wavelengths are their lifelines. Coordinating great aerial squadrons, radio guides the bombers and swarms of fighters over the targets and safely back to the airports. The paratrooper leaps from the skies with a miniature radio transmitter—no larger than a cracker-box—strapped to his belt. The artillery, through its radio, knows at all times what the infantry wants, when it wants it and exactly where it wants it.

These historic comparisons dramatize the great advances made by radio in a quarter of a century. Industrial science and private enterprise, free and unfettered, took the war-born electron tubes, the radiotelephone and the short waves and adapted them to peaceful pursuits. Clues to what might be accomplished in peace were, however, in the air during those final months of the first World War. When a subchaser dashed out to sea from a port in Maine, its radio operator moved a portable phonograph near to his radiophone microphone to broadcast a popular wartime tune, "I May be Gone for a Long, Long Time." From the Navy station at New Brunswick, N. J., the "Star Spangled Banner" was broadcast up and down the coast. These were forerunners of the day when radio music from hundreds of stations would encircle the globe.

War had revealed that new instruments could be made available for mass communication. The time was opportune and industrial science was prepared to answer the challenge. Soon after the Armistice, America became aflame with a new national pastime —that of listening-in. The vast industry of broadcasting came into being. Its achievements as a service to America and to all the world during the past quarter of a century are an epoch-making and dramatic story of American ingenuity and enterprise at its best.

In no other nation has radio developed as it has in the United States. Nowhere else are people better informed. To-day this country is served by more than 900 broadcasting stations and four national networks. There are 60,000,000 receiving sets in our land. The owner of every set is free to listen to any wavelength from any country. American radio dials are symbols of freedom.

The scientists who worked out inventions and harnessed the wavelengths to equip America with this unsurpassed radio system realized only vaguely that their achievements might be used in a second World War. Theirs were the tasks of peace. They worked to make a symphony orchestra sound with perfection hundreds and thousands of miles distant from its source, and enable the human voice to ring true on the other side of the globe.

They extended the influence of news, education and religion to all parts of the earth. They made the world an open-air theater in which countless millions of people could enjoy free entertainment.

Thus, scientists made American radio the voice of freedom, so interwoven with our daily lives that we have come to think of radio as an achievement only of the twentieth century. It is, however, a child of the ages. Modern radio came into existence through a long process of evolution. The long corridors of time, through which man has conducted research and experiments, extend far into the past. They lead back to ancient Greece. There, the first electric sparks, called electrum, kindled a new science and unleashed a new force—electricity.

While the men of science were seeking to explain the mystery of these sparks, the philosophers of Greece foresaw that if democratic government were to remain effective, the range of the human voice would have to be greatly extended. Aristotle argued that the best of states might well outgrow geographical boundaries with populations reaching such size that well-ordered and efficient government could not function. He said that a democratic government required that the citizens keep in touch with one another; that their leaders know each other and that they study at first hand their common political problems and the policies necessary to meet them. But Aristotle warned that it would be impossible to accomplish this in the overgrown State, "for who could be the leader of the people in such a State, or who the town-crier, unless he have the voice of a Stentor?" It would seem that Aristotle even forecast the need for television, because he believed that the people needed to see their leaders, as well as hear them at long range.

Two thousand years later we have seen this come to pass, for science has provided government and its leaders with radio. The entire nation has become an open forum. The leader of the modern state is heard at one time by more people than Aristotle, Socrates and Plato reached in their whole life-time. Electricity has made the microphone the voice of the Stentor; our leaders talk to the people, and at the same instant they are heard around the world.

We of this generation have seen men of evil intent stopped by the very tools of science they perverted ruthlessly to extend their power. We have watched science halt the tyrant and dictator as the stentorian voice of the United Nations cried out in defense of freedom, democracy and justice.

When this war ends, we shall be on the threshold of a new era in radio—an era in which man will see, as well as hear, distant events. The first two decades of this century belonged to wireless telegraphy. The second two decades featured sound broadcasting; the third two decades promise television. It is not too bold to predict that the fourth two decades will introduce international television with pictures in color.

It is even possible that in the two final decades, we may complete the century with power transmission by radio, and its use in the operation of vehicles, automobiles, ships, railroads and airplanes. When completed, the story of these first hundred years of radio

will make fascinating reading. Even a Jules Verne could not tell us all that lies ahead in this magic realm of radio-electronics.

The science of radio is no longer confined to communications. Among revolutionary accomplishments —in other lines, we have the electron microscope, one of the most important new scientific tools of the twentieth century. Developed in RCA Laboratories, and based upon television techniques, this instrument has a high wartime priority rating for use in scientific, medical and industrial research. For the first time, it has made it possible for us to see and identify molecules and to photograph the influenza virus. It has revealed, in infinite detail, the true structures of fibers, crystals and pigments. The submicroscopic world is now opened wide for exploration. Bacteria, tissues and minute particles of matter have been brought within range of man's eye, for the electron microscope, many times more powerful than the strongest optical microscope, permits magnifications up to 100,000 diameters. A needle on such a scale of magnification would appear as huge as the Washington Monument; a blood corpuscle as large as the wheel of an automobile and a football field, five times the size of the United States.

Wartime industrial research and engineering have rushed into use still another branch of radio—the art of utilizing high-frequency radio waves for heating. It violates no military secret to report that in this new field of radio-thermics, a laminated airplane propeller can be processed in minutes compared with hours required by ordinary heat and pressure methods. In many cases where uniform heat under accurate control is necessary in industrial processes, radio-thermics offers great promise in efficiency and time saving. The wide scope of its application ranges from case-hardening steel to dehydrating foods, from gluing prefabricated houses to seaming thermoplastic materials by means of a "radio sewing machine." These accomplishments are all based upon the simple fact that micro-waves, in penetrating an object, encounter resistance and create heat.

Further afield from communications, research men are exploring supersonic vibrations, far above the range of the human ear. The use of these ultra-sonics in chemistry may open a field in which high-intensity sound accelerates chemical reactions. Experiments also indicate important possibilities in many other fields, including underwater-communication, emulsification of liquids and precipitation of dust from the air.

We attribute all these lines of progress to the science of electronics. The heart of that science is the radio tube. Millions and millions of radio-electron tubes are on duty around the world. They are being manufactured in the United States at the rate of 400,000 a day. And a very important part of this production is right in your own home town—in the RCA plant at Lancaster. The communities in which they are made are on the front line of production. The great importance of each radio tube that moves off the production lines can only be envisaged by considering the many functions it performs in helping to win the war. The delicate finger of the worker who makes the tubes has a task as vital as the finger of a soldier on the trigger of a rifle.

Likewise, radio-electron tubes are as important in peace as in war. They are the master keys to revolutionary advances in radio. They have registered the sound of footprints in the past; they are the pulse of the present, and the "eye" of television that sees far into the future.

The day may come when every person will have his own little radio station tucked away in his pocket, to hear and to speak with his home or his office as he walks or rides along the street.

We have much to learn about the micro-waves, in which is wrapped up this new world of individualized radio. Tiny electron tubes may make it possible to design radio receivers and transmitters no larger than a fountain pen, a cigarette case, a billfold or a lady's powder-box. Some day people may carry television screens on their wrists, as they now carry watches. For, as the useful spectrum of radio approaches the frontiers of light, the apparatus will become simpler and more compact.

To-day science is leading us out of a world in which radio has been blind. To-morrow we shall have radio sight. By this I do not mean that we shall look only at pictures in motion that travel through the air. Radio-vision will have many uses. It will serve wherever sight is needed. For instance, it will be used to prevent collisions on highways and railroads, on sea lanes and on the airways of the world. Radio will be the new eye of transportation and commerce. Applications of radio optics are unlimited. With radio ear and eye to guide them, the great stratoliners will be super-human in their instincts of hearing and seeing as they speed through space with passengers and freight. Radio, which made the world a whispering gallery, will turn it into a world of mirrors.

Radio's great responsibilities do not stop there. A formidable task lies ahead for communications in the restoration of peace, in the reconstruction of the world and in the re-establishment of international trade.

If American industrial science is to play its destined role in the reconstruction period, government should not unduly restrict private enterprise or enter into competition with industry. On the other hand, it is of no avail for industry merely to point to the dangers

of governmental restraints. Industry must give evidence of leadership by presenting practical alternatives.

The day of pioneering in America has not ended. But trail blazing now calls for joint effort by government, labor and industry. Their authority, experience and vision must fuse harmoniously to achieve success. The same spirit of give-and-take must prevail in industrial statesmanship as in national and international statesmanship. There must be but one goal—the welfare of the people and the nation.

Industrial statesmanship can accomplish more than political statesmanship in solving the post-war problems of employment, mass production, prosperity and the continued uplift of the American standard of living. Industry can be the great motive power, in the solution of these problems. The future of every American home and family depends upon it. Therefore, it is imperative that after victory is achieved on the battlefields, American industry devote the same all-out efforts to the peace that it devoted to the war. There can be no let-down. The problems of peace will be of great magnitude. After the devastation of war, mankind will be called upon to win the peace and to make that peace secure with happiness for all people. If industrial statesmanship fails in this great opportunity, then the approach to the post-war problems necessarily will be political instead of economic.

America's cultivation of science has proved the nation's salvation in modern warfare, and it must not be otherwise in peace, for pioneering and research create wealth and employment.

In considering opportunities for employment after the war we must lift our sights to the skies. Man, long confined in his activities to the surface of the earth and beneath the ground, now finds that the air is a new dimension, offering new adventures and pioneering by a new generation. The air is a universal chemical and physical laboratory in which essential elements for life on earth are created. Nature herself makes unlimited use of celestial space for transmission of light and heat from the sun. Only in recent years has man learned to use the air. Only now is he beginning to discover its tremendous potentialities. Literally out of thin air, chemists are creating new products, physicists are building new services, while man is talking on unseen waves and flying on invisible beams.

On the surface of the earth, ships and railroads, automobiles and industrial machines have created millions of jobs. Underground, coal, oil and minerals provide employment for other millions. Above the earth, aviation and radio, electronics and television can open the way for new opportunities in reemployment of war workers, and for the millions of men and women who will return from service.

It is estimated that 10,000,000 jobs which did not exist in 1940 must be found to solve the post-war problem of employment. One great hope in helping to meet this unprecedented challenge will be found in the fertile and unexplored frontiers of space. Science, offering new incentives, is beckoning capital to venture into the open skies.

We are challenged to look upward to our future.

Horace Greeley, if here to-day, might say, "Go up, young man, go up and grow up in space." There, lies the unfathomed West of this century, with no last frontier; there, lies a vast wilderness rich in resources, opportunities and adventure. The Forty-Niners of the present decade will be prospectors in research. They will travel through the air to stake their claims to fame, fortune and freedom.

To assure the full attainment of these results, private industry and the government must play their parts with the utmost honesty of purpose, encouraging individual and collective initiative. The national growth of the United States and its contributions through research and invention, are historic proof that traditional American cooperation between industry and government promotes the best public interest.

The role of government in its relationship to labor and industry should be that of an umpire. A wise government does not seek to favor either management or labor. It must be impartial, not partisan.

When the war ends, and we enter the immediate period of transition, the Government in fairness to both labor and industry must readjust its rigid wartime controls. The emergency regulations necessary in wartime, but not necessary in peacetime, should be reduced as speedily as practicable. Elimination of wartime restrictions will enable manufacturers to produce and supply the goods needed by the nation, to maintain employment and to adapt new developments in industrial science for the benefit of all people.

America must be practical. Science and industry must have American independence if they are to succeed in the gigantic task of reconversion, reemployment and world rehabilitation.

Never again can the United States be isolated and secure within its own shores. In the fact that no spot on the globe is farther than 60 hours flying time from any local airport is seen the truth that nations must live together as good neighbors. Shriveled by radio and aviation, the new world is a single neighborhood. That is not a theoretical concept. It is a fact.

To-day man can travel by train from Chicago to New York in 17 hours; he can fly in 5 hours. He

saves 12 hours, but it is of no avail if he does not use that time constructively. If people achieve more leisure, what are they to do with the newly found hours of freedom? This is one of the paramount problems that faces the post-war world. Recreation and entertainment are vital to a happy life. But to be content man must also work. Mere idleness does not produce happiness or progress. Life is measured by time; it is too fleeting and precious to waste.

Entertainment can be as refreshing as sleep. To gain new ideas and to think clearly, the brain also must have diversion. In leisure some of the greatest dreams of all time have been born and have grown into revolutionary ideas and inventions. The complete conception of the telegraph flashed into the mind of Morse while on an ocean voyage. The idea of wireless flashed into Marconi's mind while vacationing in the Alps. Great ideas in science, art and literature seldom come directly to the work-bench; they are released at unsuspecting moments when the subconscious mind has opportunity to come into its own.

In broadcasting we have an outstanding example of an art that is measured by time and linked with opportunity. The listener may use the hours to good advantage, or he may waste them. It is the use to which he puts his radio set and his freedom in selection of programs that reveals the inherent value of broadcasting. The program is the essence. If it brings laughter, if it stimulates thinking or rests the tired mind or keeps the listener informed and in touch with his fellowmen, then radio is an antidote for idleness and loneliness.

Science is a mighty ally of freedom—its advance has brought much release from drudgery and from want. However, we must progress still further. For better machines are not all that is needed to make a better life. We shall have a better world only to the extent that our social thinking and our social progress keep pace with the advance of physical science.

We are approaching the days in this struggle when the basic challenge of the post-war years will become sharper and clearer. It is a challenge that will ring out to people in all walks of life; to brains and initiative, to cooperation of government and industry, to labor and management, to religion and education. The answer will be found in the minds and hearts of men and women intent upon preserving civilization, and a world at peace.

In this month of Thanksgiving, let us be thankful that America and her Allies have the strength and determination to hold high the eternal torch of freedom. May the victory be a victory of lasting peace, so that out of the bombed and shell-torn earth will come a happier to-morrow for *all* mankind.

OBITUARY

HENRY G. BARBOUR

ON September 23 American pharmacology lost one of its outstanding representatives in the death of Professor Henry G. Barbour at New Haven. This loss was accentuated by the death of Mrs. Barbour only one week earlier. Both had long been residents of Connecticut and well-known members of the Yale community.

Henry Gray Barbour was born in Hartford, Connecticut, on March 28, 1886, the son of the Reverend John H. Barbour, a professor of theology, and Annie Gray Barbour. He traced his descent from several colonial governors of Connecticut and Massachusetts. He attended the Hartford Public High School and received his A.B. from Trinity College in 1906. In 1910 he received his medical degree from Johns Hopkins University. On September 15, 1906, he married Lilla M. Chittenden, of New Haven, the daughter of Professor Russell H. Chittenden, renowned for his studies of nutrition. Three children survive him, Henry C., Dorothy (Mrs. John D. Hersey) and Russell C.

From 1910–1911 Dr. Barbour was a fellow in pathology at Johns Hopkins University. In 1911 he did research abroad in Freiburg, Germany. In 1912 he studied in Vienna with Hans Horst Meyer, and later in London. In 1912 he received his appointment of assistant professor in pharmacology and toxicology at Yale University, where he remained until 1921. Leaving New Haven in 1921 he served as professor of pharmacology at McGill University in Montreal for two years. From there he went to the University of Louisville in 1923, where he served until 1931 as professor of physiology and pharmacology. His old associations with New Haven led him back in 1931 to Yale as associate professor of pharmacology and toxicology at the Yale University School of Medicine, and in 1940 he became research associate with professorial rank in pharmacology.

During the first World War he conducted experiments on poison gas as consultant for the U. S. Government in connection with the U. S. Bureau of Mines. He was for many years a member of the revision committee of the U. S. Pharmacopoeia and the consulting editor of "Anesthesiology." He was consulting pharmacologist also to various industrial concerns for short periods on specific problems.

Professor Barbour was interested in the physiology of heat regulation with particular reference to metabolism and water exchange and its application to clima-

tology. He had practical knowledge of calorimetry and a thorough comprehension of its principles. He had made special studies in the fields of anesthetics, antipyretics, opiates and heavy water. In his studies of the viscosity of the blood, he had worked out a widely used method for determining the specific gravity of the blood plasma. He had published some one hundred and sixty contributions to leading journals of physiology, pharmacology and biochemistry. He was the author of "Experimental Pharmacology and Toxicology," published by Lea and Febiger, Philadelphia, 1932.

He belonged to several scientific societies, including Phi Beta Kappa, Sigma Xi, Alpha Omega Alpha and the International College of Anesthetists, of which he was a fellow. He was also a member of the American Medical Association, American Physiological Society, American Pharmacological Society, American Society of Biological Chemists, American Society of Anesthetists (honorary member) and the Society of Experimental Biology and Medicine. He had been a member of the committee on drug addiction in collaboration with the Bureau of Social Hygiene in New York.

For several years before his death Dr. Barbour had suffered from cardio-vascular disabilities which prevented his undertaking routine teaching and administrative duties. Nevertheless, in characteristic fashion he refused to give up his scientific interests, and continued his scientific activities up to the day before his death. His enthusiasm had led him on several occasions to overtax his circulatory capacity and he had spent some weeks in the hospital only a few months before he died. Nevertheless, he himself said with considerable justification, "The past year has been one of the most productive of my life." He had been working on the relation of the hypothalamus to antipyretic drugs and was studying the effects of profound chilling upon temperature regulation in the body. He had even started to write a book embodying his researches of the last decade.

In addition to his scientific achievements, Dr. Barbour was known as a warm friend to many pharmacologists both in academic and industrial circles. His cheery personality contributed greatly to the informal aspects of scientific conventions both here and abroad. Indeed, many profitable ideas came out of such discussions in which he participated.

At the Yale University School of Medicine one or the other of his many friends stopped in New Haven to visit the department and conduct an informal seminar on work in progress. He was thus a focal point in professional life and will be sorely missed.

WILLIAM T. SALTER

DEATHS AND MEMORIALS

DR. JESSE G. M. BULLOWA, clinical professor of medicine at the College of Medicine of New York University since 1928, known for his work on pneumonia, died on November 9. He was sixty-four years old.

DR. F. J. W. WHIPPLE, late superintendent of the Kew Observatory and assistant director of the British Meteorological Office, died on September 25 at the age of sixty-seven years.

THE Washington Academy of Sciences celebrated on November 18 the four hundredth anniversary of publication (1543) by Andreas Vesalius (b. 1514; d. 1564) of his work on human anatomy, "De Corporis Humani Fabrica." At this meeting Dr. Howard Wilcox Haggard, director of the laboratory of applied physiology of Yale University, delivered an illustrated address entitled "Andreas Vesalius."

THE Royal Irish Academy arranged for the formal celebration in Dublin on November 8 of the first publication by Sir William Rowan Hamilton of his discovery of quaternions. November 8 was the date of the first meeting of the 1943 session, and corresponds to the date of the meeting on November 13, 1843, at which Hamilton made known his discovery. The anniversary was marked by the Government of Eire by the issue of a special stamp commemorating Hamilton's work.

SCIENTIFIC EVENTS

REORGANIZATION OF CANADIAN CHEMISTS

THE Canadian Chemical Association, the Canadian Institute of Chemistry and the Society of Chemical Industry (Canadian Section), have long conducted a cooperative policy in a number of directions, including the holding of an annual Canadian chemical convention. *Chemical and Engineering News* reports that a plan is now under consideration to unite these societies into one national chemical organization. At the convention last May in Montreal a resolution was passed empowering the councils of the three organizations to proceed with the drafting of a scheme for the formation of one national chemical organization. Accordingly, the councils appointed a Joint Committee on Chemical Reorganization to study the situation and draft a report in agreement with the resolution. The joint committee has met twice and discussions have proceeded to a point where the essential features of a new organization have been agreed to and need only be written in report form for submission to councils.

The proposed national organization would, according to the views expressed at the convention, include both professional and non-professional members and permit one strong organization in place of divided responsibility as evidenced at present. No professional standards are to be sacrificed. It is estimated that the Wartime Bureau of Technical Personnel has on file the names of approximately 6,000 qualified chemists and chemical engineers who would conceivably become members of the new organization, compared with the 2,000 or so members now affiliated with one or more of the three existing organizations.

THE NUTRITION FOUNDATION

AT the second annual meeting in New York City of the Nutrition Foundation, of which Dr. Charles Glen King is scientific director, it was announced by George A. Sloan, president, that grants of $396,040 for research in nutrition had been made during the two years that the foundation had been in operation. These grants, providing for studies in many fields of nutrition and seeking improved living conditions through dietary advances, have been made to forty-one universities, medical centers and other research institutions throughout the United States and Canada.

Mr. Sloan reported that the foundation, supported by the food industry, had in its first two years received the sum of $1,278,000 to carry on its work. The board of trustees at its meeting on November 12 approved twelve new grants-in-aid amounting to $29,900, and thirteen renewals of earlier grants, amounting to $36,000. These grants include studies of nutrient values of soybeans, P. R. Burkholder, Yale University; growth, reproduction and lactation in rats on highly purified diets, L. R. Cerecedo, Fordham University; micro-biological analysis of amino acids, M. S. Dunn, the University of California; absorption of iron compounds in anemia, P. F. Hahn, Vanderbilt University; the nutritive role of hydroxy fatty acids, R. S. Harris, the Massachusetts Institute of Technology; experimental lathyrism (toxic vetches), H. B. Lewis, the University of Michigan; pyrimidine nucleosides or nucleotides as growth factors, H. S. Loring, Stanford University; carbohydrate metabolism, DeWitt Stetten, Jr., Columbia University; nutrition in relation to relapses in rheumatic fever, R. R. Struthers, McGill University; diet and congenital malformations, Joseph Warkany, University of Cincinnati, and pyruvate metabolism, W. W. Westerfeld and A. B. Hastings, Harvard University.

Research sponsored by the foundation includes several projects which have a direct relation to the war effort, namely: A study of foods which will protect against shock and injury in battle, a study of diets for soldiers which will maintain the highest mental and physical performance, a study of diets for aviation personnel which will aid in maintaining efficiency at high altitudes, and studies of the best methods of resuscitating men who have been subjected to starvation for long periods.

At the luncheon meeting the principal speaker was Dr. Frank G. Boudreau, chairman of the Food and Nutrition Board of the National Research Council, whose address was entitled "Food and the Future." During the afternoon session, Dr. William C. Rose, professor of biochemistry at the University of Illinois, described his recent work on human protein requirement, and Dr. C. A. Elvehjem, professor of biochemistry at the University of Wisconsin, spoke on future work in nutrition.

CONFERENCE ON METHODS IN PHILOSOPHY AND THE SCIENCES

PROFESSOR WOLFGANG KÖHLER, of Swarthmore College, and Dr. Richard M. Brickner, of the Neurological Institute, New York, will be the speakers at the morning session of a symposium on "Value in a World of Fact," to be held at the New School for Social Research, New York, on Sunday, November 28, beginning at 10 A.M. At the afternoon session, devoted to "The Place of Value in the Social Scene," the speakers will be Professor Wesley C. Mitchell, of Columbia University, and Mr. Justice Thurman Arnold, of the U. S. Court of Appeals, District of Columbia. The meeting will be held under the auspices of the Conference on Methods in Philosophy and the Sciences. Professor Edwin W. Patterson, of the Columbia University Law School, chairman of the conference, will preside at both sessions.

The meeting will be open to the public on payment of a registration fee of one dollar. The scheduled addresses will be followed by discussion from the floor.

The Conference on Methods in Philosophy and the Sciences was founded in 1935 by a group of distinguished philosophers and social scientists for the purpose of combating the spread of totalitarian philosophy and of clarifying the bases of a constructive social philosophy in a democratic society. Professor John Dewey is the honorary president. The honorary vice-presidents are Dr. Adolf Meyer and Professor Mitchell. Professor A. O. Hansen, of the College of the City of New York, is the secretary.

Professor Köhler, author of "The Place of Value in a World of Fact," will present the thesis that science, in order not to reject evaluation as an essential fact in the evolutionary process, must change its own concepts to fit the nature of value. Dr. Brickner, author of "Is Germany Incurable?", will discuss the development of human values from the standpoint of the highly developed brain and its place in the evolutionary scale. Professor Mitchell will talk on the theory of value in classical economics and in the work of later

nomists who have rejected the classical theories. r. Justice Arnold will discuss the relations of fact d value in the law.

THE OREGON ACADEMY OF SCIENCE

THE Oregon Academy of Science was organized at meeting held in Corvallis on October 27, attended delegates of nearly all the colleges and universities Oregon. Representatives of state industries and of ost of the federal and state departments were also esent.

The initial move toward the organization of the ademy came on April 3 at the fifth annual Biology olloquium, when a committee was appointed "to vestigate the need for such an organization, and report back at a meeting to be held in connection ith the Corvallis convention of the Pacific Section the American Association for the Advancement of cience in June." Cancellation of the meeting of the ssociation on account of travel restrictions had deyed the report of this committee, consisting of D. B. harleton, chemistry, of Portland, representing inustry; Leroy Childs, of Hood River, representing gricultural science; H. P. Hansen, botany, of Oregon tate College; A. A. Knowlton, physics, of Reed Colege; C. R. Monk, zoology, of Willamette University; W. D. Smith, geology, of the University of Oregon; S. N. Wycoff, forestry, of the U. S. Forest Service; nd F. A. Gilfillan, director of science in the State System of Higher Education, *chairman*.

At the meeting on October 27, a tentative constitution, prepared by the committee, was adopted, and officers were elected as follows: *President*, A. L. Strand, of Oregon State College; *President-elect*, Dean J. S. McGrath, of the University of Portland; *Secretary*, F. A. Gilfillan, of Corvallis, and *Treasurer*, R. R. Huestis, of the University of Oregon.

A program meeting is planned for late in December or early in January, in Portland.

ALUMNI MEDALS OF THE COLLEGE OF THE CITY OF NEW YORK

THE Associate Alumni of the College of the City of New York presented on November 13, on the occasion of their sixty-third annual dinner which was held at the Hotel Roosevelt, the annual Townsend Harris Medals. Four medals were presented in the sciences. The recipients were Dr. Walter Timme, Charles Edward Lucke, Jerome Alexander and Dr. Philip Franklin.

The citations, read by Dr. I. Ogden Woodruff, 1900, president of the Associate Alumni and professor of medicine at Columbia University, who also acted as toastmaster, were:

Walter Timme, '93: When Geoffrey Chaucer said of his Doctor of Physik that he knew the cause of every malady —were it of hot or cold or moist, or dry—and where they engendered, and of what humor, he little knew that his words foreshadowed an important field of modern medicine, the study of glandular secretions and their balance in the human body. In this field of endocrinology you are a pioneer. As teacher, hospital consultant and specialist in practice, you have made rich contribution to the art and science of healing.

Charles Edward Lucke, '95: Long professor of mechanical engineering in Columbia University and now professor emeritus, you have been an inspiration to many academic generations. While you were training young men destined to eminence in the field you made substantial contribution to the scholarship of your subject and rendered valued service as a consulting engineer. In time of war you made your skill and knowledge available first to the Navy and later to the makers of airplanes.

Jerome Alexander, '96: Some time a teacher of chemistry, leading consultant to the chemical industry, prolific writer on scientific subjects, author of the standard treatise on colloid chemistry and of numerous articles in encyclopedias, you have significantly enlarged the bounds of human knowledge. Your reputation is not limited to your native land, for France has twice awarded you cherished decorations and many learned societies abroad have added your name to their rosters.

Philip Franklin, '18: At various times a member of the faculties of Princeton, Harvard and the Institute for Advanced Study, and now professor of mathematics in the Massachusetts Institute of Technology, your colleagues consider you one of the outstanding mathematicians in the United States. As an editor of *The Journal of Mathematics and Physics* and the author of studies in algebra and calculus you have made important contributions to scholarship.

AWARD OF THE WILLIAM H. NICHOLS MEDAL

DR. CARL SHIPP MARVEL, professor of organic chemistry at the University of Illinois, has been awarded the 1944 William H. Nichols Medal of the New York Section of the American Chemical Society.

Dr. Marvel was cited for outstanding organic chemical contributions to the structure of vinyl polymers, used as synthetic plastics, particularly in the production of transparent aircraft pieces; as rubber substitutes, and as thickening and blending agents in the chemical manufacturing industry. The citation also stressed the importance of his research in the structure of polymers of sulphur dioxide and olefines. In addition, the citation stated that Dr. Marvel had carried out notable investigations in the fields of synthetic and structural organic chemistry, including the development of practical methods for preparing amino-acids, which are becoming increasingly important in the preparation of synthetic diets for intravenous feeding.

Other studies have dealt with the relationship of

hydrogen bonding and solubility behaviors, which forms the basis for one method of electrical refrigeration operating at low pressure, minimizing explosion hazards; the identification of organic compounds; the effect of structure in hexaarylethanes; the synthesis and rearrangement of polyines and polyynes, and the organo-metallic compounds.

The Nichols Medal award was founded by the late Dr. William H. Nichols, a charter member of the American Chemical Society and chairman of the board of the Allied Chemical and Dye Corporation. It is conferred annually to stimulate original research in chemistry. The presentation to Dr. Marvel will be made at a meeting of the New York Section on March 10, 1944.

Recipients of the medal include John M. Nelson, Phoebus A. Levene, Joel H. Hildebrand, Irving Langmuir, James Bryant Conant, Frank C. Whitmore, William M. Clark, Charles A. Kraus, Hugh S. Taylor, Julius A. Nieuwland, Gilbert N. Lewis, Charles L. Parsons, Claude S. Hudson, Marston T. Bogert, Henry C. Sherman, Roger Adams, William A. Noyes, Thomas Midgley, Samuel C. Lind, Leo H. Baekeland, H. C. P. Weber, Edward C. Franklin, M. A. Rosanoff, C. W. Easley, T. B. Johnson, Charles James, M. H. Walker, M. B. Bishop, E. B. Voorhees, William L. Evans, Moses Gomberg, Samuel E. Sheppard, John A. Wilson, Linus Pauling, Duncan A. MacInnes and Arthur B. Lamb.

Members of the 1944 jury are Dr. William H. Winship, Robert Calvert, Vincent du Vigneaud, Charles N. Frey and Ralph H. Muller.

SCIENTIFIC NOTES AND NEWS

DR. TOM DOUGLAS SPIES, associate professor of medicine in the College of Medicine of the University of Cincinnati and director of the nutrition clinic of the Hillman Hospital at Birmingham, Ala., was presented with the occasional research medal of the Southern Medical Association at the opening on November 16 of a three-day wartime meeting. The presentation was made to Dr. Spies by Dr. Harvey F. Garrison, president of the association. The medal was awarded "in recognition of his outstanding contributions to our knowledge of the science of human nutrition, especially in his elucidation of earlier and better methods of diagnosis and treatment of disease."

THE Chemical Industry Medal for 1943 of the Society of Chemical Industry was presented on November 12 to Dr. John J. Grebe, director of the physics research laboratory of the Dow Chemical Company. A joint meeting was held at the Hotel Roosevelt of the American section of the Society of Chemical Industry, the New York section of the American Chemical Society and the New York section of the American Institute of Chemical Engineers. Ray H. Boundy, manager of the plastics division of the Dow Chemical Company, spoke on the personal side of the life of the medalist, and Dr. W. R. Veazey, research coordinator of the company, on his accomplishments. Walter P. Cohoe, president of the society, presented the medal. Dr. Foster D. Snell, chairman of the American section, presided at the meeting. The medal is awarded for valuable applications of chemical research to industry. Dr. Grebe was recognized for "his contribution to the solution of some of the very difficult problems connected with the automatic control of chemical reactions, particularly with reference to the anticipatory control necessary to the reactions."

THE Annie J. Cannon Prize of the American Astronomical Society for women astronomers has been awarded to Miss Antonia C. Maury, of Hastings, N. Y., for her distinguished work on the classification of spectra at the Harvard College Observatory.

DR. ROBERT E. STREET, who has been engaged in aero-dynamic research at Langley Field for the National Advisory Council on Aeronautics, has been appointed a visiting lecturer in physics at Dartmouth College.

DR. WILLIAM DOCK, professor of pathology at the Cornell University Medical School, has been appointed professor of medicine and chairman of the department of the School of Medicine at the University of Southern California.

DONALD P. SHERMAN, director of athletics at the Michigan College of Mining and Technology, Houghton, has been promoted to a professorship of physical education.

DR. FRANK E. NELSON, associate professor of dairy bacteriology at Kansas State College, has been named professor of dairy industry at the Iowa State College and research professor at the Agricultural Experiment Station. He succeeds Professor B. W. Hammer.

MCGILL UNIVERSITY announces the establishment of a department of psychiatry and, in association with the Royal Victoria Hospital, the establishment of an institute for research and teaching. Dr. D. Ewen Cameron has been appointed to the chair of psychiatry and will be director of the institute. Through the generosity of Sir Montagu and Lady Allan, a building and an extensive site have been provided. The institute will contain fifty beds for patients suffering from

early and acute psychiatric conditions. Facilities for intensive treatment are being set up. The development of research and treatment will be major objectives, and with this in view large and well-equipped laboratories will be provided. The project is being supported both by the Rockefeller Foundation and the Government of the Province of Quebec.

THE *Harvard Alumni Bulletin* reports that Dr. Chocheng Chu, for many years a professor in the National Chekiang University and director of the Institute of Meteorology, is now president of the university.

DR. C. W. THORNTHWAITE, climatologist in the U. S. Soil Conservation Service, is in Mexico, on a special assignment with the Mexican Government. He is making climatic studies for the benefit of agriculture and irrigation, and is initiating special microclimatic studies at the National College of Agriculture in Chapingo.

DR. ROBERTO SOUZA COELHO, director of the Pasteur Institute of Rio de Janeiro, is in the United States on a mission for the Brazilian Government to study rabies. He planned to spend a month at the Rockefeller Institute for Medical Research, and later to go to Washington and to Montgomery, Ala., where studies on hydrophobia are being made.

DR. NEWTON J. T. BIGELOW has been appointed New York State assistant commissioner of mental hygiene. He succeeds Dr. H. Beckett Lang, now a lieutenant commander in the Navy, who is on leave of absence for the duration of the war.

THE *Journal* of the American Medical Association reports that Dr. John Moore Campbell, Jr., director of health conservation of Pennsylvania, has been appointed deputy state secretary of health in charge of medical affairs. Dr. Campbell has been a member of the department for many years. In 1911 he became pathologist in the Philadelphia Laboratory and three years later moved to Harrisburg, where he was placed in charge of communicable disease control work.

DR. ROBERT C. HOCKETT, associate professor of organic chemistry at the Massachusetts Institute of Technology, has been appointed scientific director of the Sugar Research Foundation, a non-profit organization. Research into the chemical and nutritional properties of sugar is planned. The aims of the foundation, which was formed last June, include the sponsoring of research and scientific studies at universities and other research institutions on uses or potential uses of sugar, and the dissemination of accurate information. The foundation is supported by cane sugar refiners and beet sugar processors, as well as the raw sugar producers of Hawaii, Louisiana and Puerto Rico.

JOHN R. BANGS, formerly head of the department of administrative engineering at Cornell University, has taken up work as general manager of industrial and personnel relations of the Edward G. Budd Manufacturing Company.

NELSON W. TAYLOR, head of the department of ceramics at Pennsylvania State College, has resigned in order to take charge of ceramic research for the Minnesota Mining and Manufacturing Company, St. Paul.

LIEUTENANT (JG) BURNEY BENNETT, associate professor on leave from the staff of the Michigan College of Mining and Technology, has gone abroad as a member of the Educational Services Section, Training Division, Bureau of Personnel of the United States Navy. Ensign Robert Harper, also on leave, has been promoted to the rank of lieutenant (jg). He is engaged in hydrographic and educational work at a non-continental base.

PROFESSOR WILLIS H. RICH, of the Natural History Museum of Stanford University, has leave of absence to enable him to accept a war service appointment with the Fish and Wildlife Service. For several months he served as administrator of fishery production in the Office of the Coordinator of Fisheries with headquarters in San Francisco where he was concerned with the administration of the Pacific sardine industry. In October he was transferred to the Seattle laboratory of the Fish and Wildlife Service, acting in charge of North Pacific Fishery Investigations. In this capacity he will be primarily engaged in making a general survey of the present salmon research program and will direct such modifications as may seem desirable in order to adapt the program to present needs.

DR. B. A. KEEN, assistant director at Rothamsted Experimental Station, England, has leave of absence for approximately twelve months to act as a scientific adviser to the Middle East Supply Center, Cairo. He will report, according to *Nature*, on the scientific and technical problems and resources (including personnel) in the area, and make recommendations on the establishment of a suitable organization in the Middle East and elsewhere to ensure the fullest practicable service of information and advice, with special reference to the post-war period. Dr. Keen will study agricultural resources and development, and related problems, including education. He will be accompanied by Dr. E. B. Worthington, who will examine various non-agricultural matters. An American representative is expected to join the mission at a later date. The countries to be visited extend from Persia to Libya and from Turkey to the Sudan. It is hoped that the mission will be able to report by November, 1944.

THE Charles Sumner Bacon Lectures of the College of Medicine at Chicago of the University of Illinois for 1943–1944 will be delivered on December 1 and 2 by Dr. Louis E. Phaneuf, professor of gynecology at Tufts College Medical School, Boston.

THE Arthur E. Hill Memorial Lecture of the Alpha Lambda Chapter of Phi Lambda Upsilon was given at New York University on November 13 by Professor J. P. Simmons, director of the Nichols Laboratory. The lecture was entitled "Dr. Hill, the Man." Professor John E. Ricci, an associate editor of the *Journal* of the American Chemical Society, discussed Dr. Hill's work. Professor Hill had been head of the department of chemistry at the university from 1912 until his death in 1930.

THE inaugural lecture of the faculty of medicine of the University of Leeds was given on October 20 by Sir John Graham Kerr, F.R.S., emeritus professor of zoology of the University of Glasgow. He spoke on medicine and education.

THE twenty-seventh annual meeting of the Mathematical Association of America will be held at Chicago on November 27 and 28, in conjunction with the meetings of the American Mathematical Society. The sessions will be held at the Museum of Science and Industry, opening at 9:30 A.M. on Saturday. The sessions of the American Mathematical Society will begin on Friday at 9:30 A.M. and will continue through Saturday afternoon. On Friday at 11:30, by invitation of the program committee, Professor Reinhold Baer will deliver an address on "The Higher Commutator Subgroups." The seventeenth Josiah Willard Gibbs Lecture will be given on Friday at 7:45 P.M., by Professor Harry Bateman. The title of this lecture is "The Control of Elastic Fluids." On Saturday at 2:00 Professor Marston Morse will deliver the address of the retiring president. He will speak on "New Settings for Topology in Analysis."

ARRANGEMENTS are being made for the holding of the annual convention of the Society of the Sigma Xi at Chicago on Saturday, December 4. The headquarters for the meeting will be at the Shoreland Hotel. On Friday evening, December 3, the president of the society, Dr. Harlow Shapley, will present the annual Sigma Xi lecture at the University of Chicago. His subject will be "Star Clusters and the Dimensions of the Galaxies." On the same evening a subscription dinner in honor of Dr. Shapley will be held at the hotel at 6 o'clock. Members of the society in the Chicago area are cordially invited to attend the dinner and the lecture. Reservations should be sent to Professor G. P. DuShane, Department of Zoology, University of Chicago, before December 2. The local committee on arrangements includes representatives of the local chapters as follows: University of Chicago, G. P. DuShane and H. I. Schlesinger; University of Illinois, G. L. Webster and M. K. Hines; Northwestern University, R. H. Seashore and J. M. Dobbie; Illinois Institute of Technology, R. Oldenburger, Paul L. Copeland and H. J. McDonald.

OREGON STATE COLLEGE at Corvallis celebrated its seventy-fifth anniversary on October 27. The observance was limited to a formal convocation, attended by the faculty, the student body, alumni in the vicinity and a few delegates from other institutions. The commemoration address was delivered by President Dale, of the University of Idaho, and greetings were extended by Governor Snell of Oregon and by the presidents of the Alumni Association and of the Associated Students.

THE chemical patents and patent applications vested by the Alien Property Custodian have been abstracted by the Chicago Section of the American Chemical Society and are now being indexed by a committee of the Science and Technology Group of the Special Libraries Association. Beginning in January, 1944, these abstracts will be published in thirty-one classified, indexed pamphlets, to be followed by a master index and a supplement of new abstracts. Many libraries will want a reference copy and a circulating copy. The paper situation necessitates close adjustment of the printing to the known demand; orders should be placed not later than December 10 to make sure of receiving copies. Order blanks (already sent to all members of the American Chemical Society and of the Science-Technology Group of the Special Libraries Association) may be had from the Alien Property Custodian, Field Building, Chicago 3, Illinois.

A GIFT conservatively estimated as about $200,000 has been accepted by the University of Wisconsin Board of Regents from two anonymous donors who signed themselves simply as "Two Friends of the University." The gift, made up largely of cash and securities in American industries, was tendered in recognition of "the outstanding service of the University of Wisconsin to the state and to the nation, and to the young people who come to the campus." The only condition attached to the gift is that it "remain completely and forever anonymous."

THE School of American Research, Santa Fe, N. M., has received from Dr. and Mrs. Edgar L. Hewett a gift of real estate, investments, a library, and art and handicraft collections. The presentation was made at the annual meeting of the boards of the school and of the Museum of New Mexico at Santa Fe on September 2. At the same time the Hewett Foundation was established to augment the work of the school.

The gift, together with the testamentary disposition of assets to be added, will give the new foundation properties and collections valued at $100,000. Dr. Hewett has been director of the school since 1907 and president of its executive board since 1930; he has also been director of the museum.

DISCUSSION

THE STABILITY OF THIAMIN IN DEHYDRATED PORK

THAT thiamin, being heat labile, is partially destroyed during the cooking or processing of foodstuffs has been shown by a number of investigators. When foods are prepared for immediate consumption such losses presumably measure the total decrease in thiamin content. However, foods which must be stored at warehouse or dock temperatures (which may range up to 130° F.) for long periods of time may undergo further reductions in vitamin content. With certain vitamin-rich foods, these storage losses may be quite significant.

Marked decreases in the thiamin content of some dehydrated foodstuffs have been noted in studies of vitamin retentions during storage. Some other foods appeared to be quite stable under the same conditions. This led to an investigation of a possible stabilizing effect on thiamin by these latter foods. Experimentation demonstrated that dehydrated pork, which shows little retention of thiamin after several weeks' storage at 120° F., may be stabilized with respect to thiamin to a great extent by the inclusion of a mixture consisting largely of cereals, milk, tomato paste and bonemeal.[1]

This stabilizing action was first noted during storage studies of a pet food containing meat and meat by-products along with approximately 33 per cent. of the aforementioned mixture. When cooked and dehydrated, such a product retained most of its thiamin for several weeks at 120° F., a temperature known to cause severe destruction of thiamin in dehydrated meats or eggs. That the stabilization was due to the influence of constituents of the cereal-milk-bone mixture has been demonstrated by preparing and storing two samples of dehydrated pork (6 per cent. moisture) from one lot of well-mixed meat, one containing 33 per cent. of the cereal preparation and the other being unsupplemented. The latter retained 15 per cent. of the original amount of thiamin (thiochrome procedure) after one week's storage at 120° F., as compared with a 74 per cent. retention for the supplemented sample. Thus the effect of the added ingredients is quite marked.

While it is doubtful that this particular cereal-milk, bone mixture is specific for decreasing thiamin loss, its effect is positive and gives a starting point for studies of the nature of the loss and of possible ways of minimizing it. If further work shows that there is actually a stabilizing factor present in this mixture and that the effect is not owing merely to physical changes, the way will be opened for the preparation of foods that are nutritionally as well as bacteriologically stable.

E. E. RICE
J. F. BEUK
H. E. ROBINSON

[1] Cracked wheat 34.2 per cent., ground barley 21.7 per cent., soya flour 27.6 per cent., bonemeal 7.2 per cent., dried skim milk 5.5 per cent., salt 2.3 per cent., tomato paste 1.65 per cent., sardine oil 0.25 per cent. and gum guaiac 0.16 per cent.

BIRTH OF A TWO-HEADED MONSTER IN THE RHESUS MONKEY

IN the June 17, 1938, number of SCIENCE I gave my own interpretation of the manner in which a rhesus female (acquired by the Carnegie Laboratory of Embryology as No. 636) had come into possession of three babies, reported in New York newspapers about April 17, 1938, as triplets. The facts are (1) that she was in possession of three babies when the boat arrived in New York harbor and (2) that she gave birth to at least one baby, for the act of parturition was witnessed.

In the cage with the female were five others, all of which were acquired by me and their uteri and breasts palpated. It appeared that one of the five had also just given birth to a baby; hence I concluded that it was kidnapped by No. 636. A third female had probably also become a mother, though the evidence was less clear than in the other case. Since in addition No. 636 was laparotomized and found to possess but a single corpus luteum, it was thought that the charge of double kidnapping was all but proved.

The sequel to this story is this: On December 5 of the same year she conceived again and on April 13, 1939, on the 143d day of gestation, delivered a monster with two partly united heads and a doubling of the spinal column from the mid-thoracic region upward. The rest of the body seems normal.

In view of this abortive attempt at twinning one naturally wonders if the mother should not perhaps be credited at least with twins (though not with triplets) in the preceding April. The data, however, are too uncertain to be used to bolster the much discredited theory of the hereditary tendency to produce duplicate twins.

On January 15, 1940, the animal in question furnished a normal 35-day-old embryo (Carnegie No. 640).

CARL G. HARTMAN
URBANA, ILL.

CHOLINESTERASE

IN SCIENCE for August 27, 1943 (98: 2539, 201) occurs an interesting article by Mendel and Rudney, concerning cholinesterase. The authors refer to the existence of two esterases capable of hydrolyzing acetylcholine, but cite as first publication of this fact their article in the *Biochemical Journal* (37: 59, 1943). The existence of these two esterases was thoroughly demonstrated and reported by G. A. Alles and R. C. Hawes in the *Journal of Biological Chemistry* (133: 2, 375, April, 1940), also by R. C. Hawes and G. A. Alles in the *Journal of Laboratory and Clinical Medicine* (26: 5, 845, February, 1941).

Mendel and Rudney refer to one of these esterases as "pseudo-cholinesterase." This seems an unfortunate designation, since most of the published references to cholinesterase probably refer to the one receiving the prefix "pseudo." It would be helpful to biologists if the authors would select some other nomenclature for discriminating between the two.

M. W. DE LAUBENFELS

PASADENA, CALIF.

A FEW WORDS ON RUSSIAN NAMES

I HAVE followed with great interest the discussion of transliterating Russian names by Drs. Hrdlička (SCIENCE, 97: 243), Dunlop (*ibid.*, 97: 400) and Chester (*ibid.*, 98: 302).

My long experience in library and bibliographical work has led me to the conclusion that the basic trouble in transliteration of Russian names is the lack of uniformity in such work. This could easily be avoided if the rules of the Library of Congress were strictly followed. In fact, they are often ignored even in library practise.

In one library I found the papers of the well-known Russian botanist "Кузнецов" (Kuznetsov) scattered in five places in the catalogue, but at least they all were under the letter "K." Much worse was the case of another botanist "Железнов" (Zheleznov), whose works were under "G," "J" and "Z." But I never saw a more extravagant use (or misuse) of the English alphabet than in the transliteration of the name of "Щеглеев" (Shchegleev) in which the first Russian letter was represented by the craziest combination of 7 English letters. After that experience I can only smile when K. Starr Chester says that "shch" is a rather clumsy equivalent for that letter.

The above cited examples show to what extent some transliterators may go if they do not adhere to a certain definite standard.

The rules of the Library of Congress are certainly not perfect, and I concur with K. S. Chester that "ya" is better than "i͡a" for "я" and "yu" is preferable to "i͡u" for "ю." On the other hand I disagree with him that "ch" is equivalent for "ц"; it is probably a misprint for "ч." I could recommend some minor improvements, as using "ë" for Russian "e" in order to distinguish it from "э." The Library of Congress uses "e" for both letters.

But, in all, the rules of the Library of Congress are quite satisfactory, even in the present form, and the strict use of them will bring uniformity in the transliteration of Russian words and benefit greatly all persons engaged in research work on Russian literature.

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SCIENTIFIC BOOKS

HUMAN GASTRIC FUNCTION

Human Gastric Function: An Experimental Study of a Man and His Stomach. By STEWART WOLF, M.D., and HAROLD G. WOLFF, M.D., with a foreword by WALTER B. CANNON, M.D. 195 pages, including appendix, bibliography, index and 42 illustrations, one in color. New York: Oxford University Press.

As Dr. Cannon points out in the foreword there have been in the United States two previous famous studies of the human stomach made in individuals with gastric fistulae: Dr. William Beaumont's classic report of his experiments and observations on Alexis St. Martin and Dr. Anton J. Carlson's extensive work with Fred V. Beaumont concerned himself primarily with the digestive function of the gastric juice, Carlson with gastric motility, particularly "hunger contractions." The present monograph is a complete report of studies made in a patient, Tom, with a gastric fistula similar to that of St. Martin and Fred V. Some of the work has been published previously elsewhere. It is not entirely new, but it is meticulously thorough. It differs from the earlier studies primarily in its broader orientation, being a study of both the "man and his stomach." As the authors note in their introduction an investigator's horizon is usually limited by the vantage point on which he stands, the vantage points being the prevailing concepts of his day, and few men have been able to look beyond the horizon of their generation. Wolf and Wolff have been quick to sense the implications for gastric physiology of the old mind-body problem now returning to style as psychosomatic medicine and to subject

it to scientific study. The work was well planned, brilliantly executed and conservatively appraised. It deserves to rank with the classic studies of Beaumont and of Carlson as a milestone on the road to a better understanding of gastric function and disease.

The description of the appearance and behavior of a stomach after forty-seven years of feeding through a gastric fistula is important because of the normality found. The authors found that gastric vascularity as measured by variations in color (Munsell method) reflected changes in blood flow. Simultaneous observation on gastric vascularity, motility and secretion disclosed that hyperemia always accompanied increased parietal cell output. The stomach emptied only during periods of vigorous contractions. The introduction of fluid into the stomach or duodenum inhibited gastric contractions, the duration of the inhibition varying with the quantity and nature of the fluid and the time of its introduction. The rate of parietal cell output was estimated under a variety of conditions. Exposure to cold (environmental), the application of ice bags locally and irrigation of the stomach with cold water inhibited gastric motility and parietal cell secretion and produced pallor. With returning warmth the mucosa became redder, the motility grew more active and the secretion increased. Tobacco smoking produced no definite effect as long as it was a pleasurable experience. Nausea induced by any method was uniformly accompanied by mucosal pallor, hypomotility and hypoacidity. The introduction of acid (20 cc of 0.1 or 0.34 N HCl) into the stomach inhibited motility and parietal cell secretion and increased the secretion of mucus. Antacids (sodium bicarbonate, calcium carbonate, magnesium oxide, aluminum hydroxide) exerted no measurable effect on secretion. Nitrites (amyl nitrite, nitroglycerine) inhibited gastric motility and tone. In general, drugs producing flushing or pallor of the face tended to produce flushing or pallor of the gastric mucosa also. Atropine inhibited both gastric motility and secretion.

As a basis for a study of the "situational factors," the correlation of gastric function with the behavior of the individual as a whole, the authors present a comprehensive and skilful analysis of the background and personality of Tom whose emotional and social development had been profoundly influenced by a difficult family life in childhood and the accident at the age of 9. The gastrostomy prevented him from eating with the family, friends or strangers, thus accentuating his feelings of inadequacy and tending to develop shyness and suspicion. He was not given to fantasy. On the whole his adjustment to life was adequate in spite of the handicap.

In studying the effect of emotions upon gastric function the authors did not use experimentally induced situations but rather utilized the spontaneously occurring conflicts and problems. Thus the stomach was found to respond to stimulation of the appetite with increased vascularity and secretion. Fear produced pallor and inhibited secretion as did sadness and self-reproach. On the other hand, when the subject came to the laboratory "bursting with resentment," the gastric mucous membrane was "turgid, engorged, much redder than usual," the level of secretion "in terms of volume, acidity, and parietal cell output was three times normal"; gastric activity was accelerated. During two weeks of sustained anxiety and chronic emotional conflict the mucosa was continuously engorged and reddened, measuring 70 per cent. on the color scale compared with 56 per cent. for the preceding two weeks and 50 per cent. for the two weeks after the emotional stress had been relieved by an increase in pay. The average thirty-minute fasting gastric secretion was 3.6 cc for the initial control period, 5.5 cc for the two weeks of conflict and 3.0 cc for the second control period. Flight or withdrawal reactions seemed to be accompanied by a depression of gastric function, whereas the unfulfilled desire for aggression and fighting back was accompanied by increased vascularity, motility and secretion.

With regard to sensation it was found that heartburn resulted from stimulation of the mucosa lining the cardiac end of the esophagus. Touch sensation was absent in the gastric mucosa, whereas pressure sensation was appreciated and roughly localized. Temperatures above 40° C. were appreciated as heat, those below 18° C. as cold, those between not felt. Pain could not be elicited by stimulation of the normal mucosa, whereas when vascular engorgement, inflammation and oedema were present minor stimuli caused pain, indicating a lowering of the threshold. Sudden distension of the muscular and peritoneal coats and unusually vigorous contractions both produced pain. The threshold for pain varied with the condition of the tissues and was lowered by vascular engorgement, inflammation and oedema.

The undue and prolonged acceleration of acid secretion in the stomach resulted in a hyperemia and engorgement of the mucous membrane resembling the gastroscopic picture designated as hypertrophic gastritis. Trifling traumata to the mucosa in this state resulted in hemorrhages and small erosions. Ordinarily the mucosa was protected by an effective coating of mucus. With loss of this protection minor injuries led to oedema, inflammatory changes, erosions and hemorrhages. The contact of acid gastric juice with a denuded surface induced further hyperemia and acceleration of gastric secretion. Prolonged contact

of acid gastric juice with a minor erosion resulted in the formation of a peptic ulcer. The application of strong acid to the inflamed and eroded mucosa did not produce pain, although it might have done so with more intense inflammation and a further lowering of the pain threshold.

In the final formulation of the work with its clinical implications the authors consider the objective in the management of patients with gastritis and ulcer to be clearly that of preventing or controlling gastric hyperfunction, the problem thus resolving itself into the care of the man rather than his stomach. "It is to be hoped that factors of emotional conflict, on the one hand, and security on the other will be more directly dealt with in the future. . . . Dealing actively with the patient's life situation and his reactions to it may then be adequately judged as a means for the control of 'dyspepsia,' gastritis and peptic ulcer." The reviewer does not question the importance of this approach, but he is not persuaded that adequate care of the diseased stomach can be regularly accomplished thereby. Complete emotional tranquility often seems a utopian dream rather than a possible achievement in a real world with its inevitable problems, frustrations and insecurities. Nevertheless dreams may provide goals. The authors have established relationships and mechanisms; they have indeed pointed beyond the horizon.

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SPECIAL ARTICLES

TRANSMISSION TO RODENTS OF LANSING TYPE POLIOMYELITIS VIRUS ORIGINATING IN THE MIDDLE EAST[1]

DURING 1941–42 a number of cases diagnosed as poliomyelitis or encephalitis were reported[2] in the Middle East Forces of the British Army. Other neurological syndromes observed among the troops in the same area at that time were tentatively designated as "lymphocytic choriomeningitis," "polioencephalitis," "brachial neuritis," "wasting" of various groups of muscles. A number of specimens derived from these cases were made available to us for investigation.[3]

The materials consisted of fragments of human and monkey spinal cord and brain, immersed in glycerolated saline solution, and many of them had been in transit for several weeks at different seasons of the year. The monkey tissues were from Abyssinian grivets and baboons (*C. griseoviridis* and *P. hamadryas*) which had developed paralysis after inoculation of human materials by Major Van Rooyen.

Transfers to monkeys: Of tissue specimens derived from seven cases, three proved to be infectious for *rhesus* monkeys.

(a) Strain MEF1: The material received was labeled "monkey and baboon cords, 1st passage." Bacterial culture yielded no growth; intracerebral inoculation of a 10 per cent. suspension in broth into rabbits, guinea pigs and mice, and injection into embryonated eggs gave negative results. Intracerebral inoculation into two monkeys led to characteristic flaccid paralysis on the 12th day in one, while the other one was sacrificed on the 9th day when showing tremor and weakness of the hind limbs. Typical lesions of experimental poliomyelitis were present in the spinal cord and brain of this animal. Nevertheless, four monkeys inoculated with a suspension of this cord remained well.

A second isolation of virus from the original material was made and this time the virus could be maintained through another passage. Two monkeys inoculated with a mixture of the original material and pooled poliomyelitis (MV and Philadelphia strains) monkey antiserum remained well.

(b) Strain MEF2: The specimen received was baboon cord. Culture yielded no bacterial growth. Transfer into mice, rabbits, guinea pigs and chick embryos failed. Two monkeys, inoculated intracerebrally with a 10 per cent. suspension in broth, developed characteristic paralysis and in one instance histological study revealed typical poliomyelitic lesions. In the same test, one monkey paralyzed following infection with Strain MEF1 remained unaffected by Strain MEF2, while a second one which, after injection of Strain MEF1, had had only fever for 5 days, came down with quadriplegia. A mixture of virus and anti-MV-Philadelphia-poliomyelitis monkey serum was injected into two monkeys. One of these developed paralytic poliomyelitis, while the other one may have had an abortive attack (fever and weakness on the 6th day after inoculation).

(c) Strain MEF6: The original material was human cord tissue heavily contaminated with bacteria. All

[1] This investigation was made in collaboration with the Commission on Neurotropic Virus Diseases, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army.

[2] C. E. Van Rooyen and A. D. Morgan (in press).

[3] Numerous human sera and specimens of nervous tissues were sent by Major C. E. Van Rooyen, R.A.M.C., to Captain T. M. Rivers, M.C., U.S.N.R., whose guidance and encouragement made this work possible. We also wish to thank Major Van Rooyen for his enthusiastic cooperation under difficult conditions, and Colonel J. S. K. Boyd, R.A.M.C., for his gracious permission to publish the results here presented.

n mice, one of three guinea pigs, and three of four bbits injected intracerebrally with centrifuged wice at 10,000 r.p.m.) suspension succumbed to bac- rial meningoencephalitis. The survivors remained ell for several months. Through two passages mon- eys developed characteristic poliomyelitis in absence f bacterial contamination. One monkey with residual ind-limb paralysis following infection with Strain EF1 became completely paralyzed when reinocu- ted with Strain MEF6.

Comment: Identification of all three strains as polio- yelitis virus was based on (1) host range, (2) typical isease produced in *rhesus* monkeys, and (3) lesions in the central nervous system (CNS) of infected mon- keys. In addition, one strain (MEF1) was neutral- ized by a standard anti-poliomyelitis monkey serum. The tests in which monkeys convalescent from MEF1 infection were reinoculated with the other two strains permit no definite conclusion as to the relationship between the agents. The frequent occurrence of "cross-immunity" on consecutive intracerebral inocu- lation of serologically unrelated poliomyelitis viruses has been described by others.[4]

Transfers to cotton rats, hamsters and mice: Cotton rats (*Sigmodon hispidus hispidus*) remained well after intracerebral inoculation of Strain MEF2, original baboon cord, and Strain MEF6, human or *rhesus* cord; these were infectious for monkeys. Moreover, with Strain MEF6, three intracerebral blind passages at 4-day intervals in cotton rats were ineffective.

Two of the three cotton rats inoculated with Strain MEF1-infected *rhesus* tissue developed flaccid hind-limb paralysis on the 14th and 15th days, respectively. The same material, with addition of a small portion of the MEF2 baboon cord, which in itself was non-infectious for cotton rats, was given intracerebrally to six hamsters and five cotton rats. Two consecutive blind passages were made at 4-day intervals in both species, using two animals as source of transfer mate- rial. All hamsters thus inoculated survived. The CNS tissue of those sacrificed showed no lesions. Eleven of twelve cotton rats left for observation developed flaccid paralysis after 11 to 22 days' incubation. Subse- quently six more cotton rat to cotton rat passages were carried out (Fig. 1).

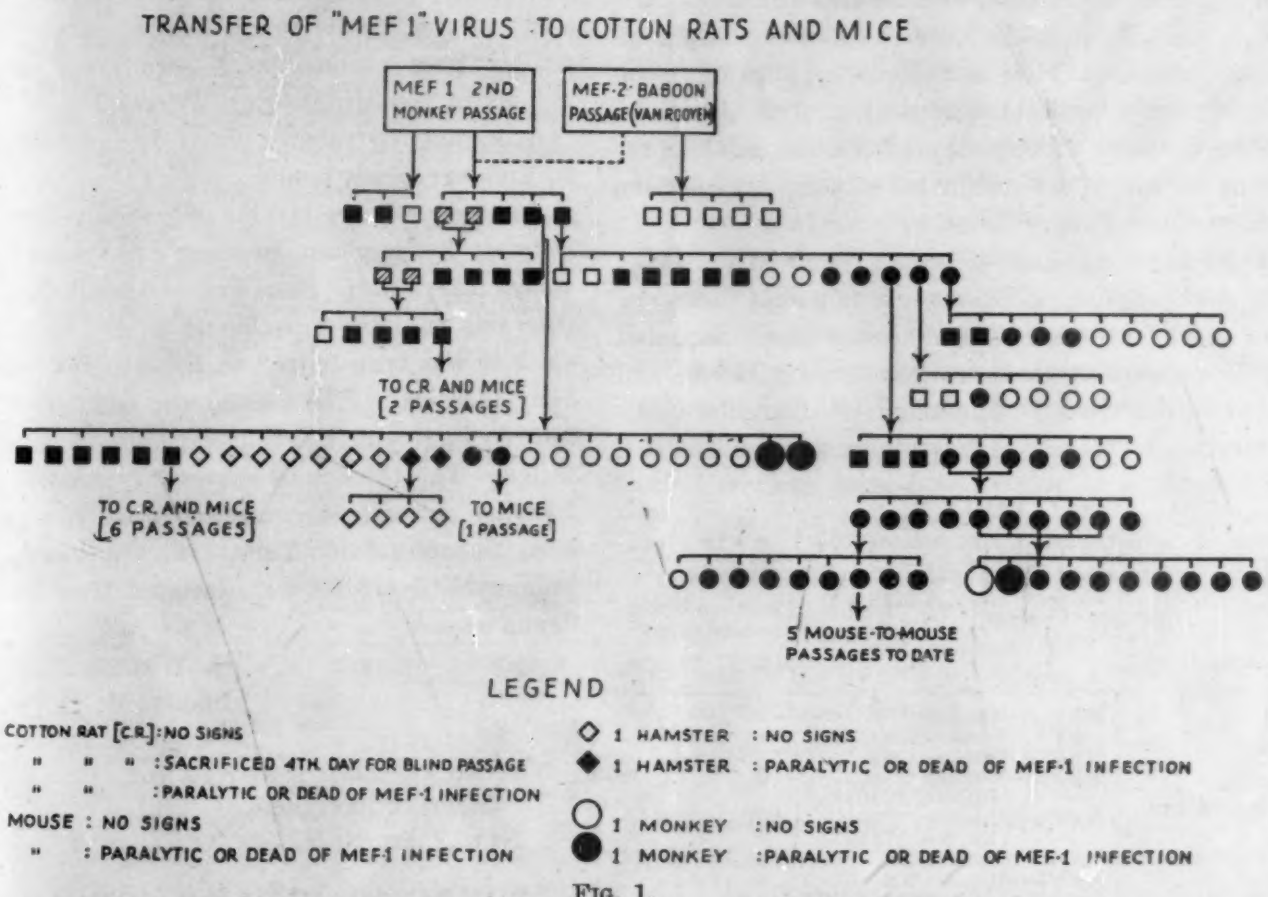
TRANSFER OF "MEF 1" VIRUS TO COTTON RATS AND MICE
MEF 1 2ND MONKEY PASSAGE
MEF-2 BABOON PASSAGE (VAN ROOYEN)
TO C.R. AND MICE [2 PASSAGES]
TO C.R. AND MICE [6 PASSAGES]
TO MICE [1 PASSAGE]
5 MOUSE-TO-MOUSE PASSAGES TO DATE
LEGEND
1 COTTON RAT [C.R.]: NO SIGNS
" " " : SACRIFICED 4TH DAY FOR BLIND PASSAGE
" " : PARALYTIC OR DEAD OF MEF-1 INFECTION
1 MOUSE : NO SIGNS
" : PARALYTIC OR DEAD OF MEF-1 INFECTION
1 HAMSTER : NO SIGNS
1 HAMSTER : PARALYTIC OR DEAD OF MEF-1 INFECTION
1 MONKEY : NO SIGNS
1 MONKEY : PARALYTIC OR DEAD OF MEF-1 INFECTION

FIG. 1.

Nine hamsters received intracerebrally a pool of brain and cord from two paralyzed cotton rats. On the 16th day, one was found dead; another one had flaccid fore-limb paralysis. Passage from this one into four others was unsuccessful. Further tests in hamsters remain to be done.

Four of seven mice inoculated intracerebrally with the CNS tissue derived from the first infected cotton rat became paralyzed after 5 to 18 days. Four other cotton rat to mouse passages and subsequently five mouse to cotton rat passages transmitted the agent. In addition, fourteen mouse to mouse transfers have been carried out thus far. Two monkeys inoculated

[4] J. F. Kessel and F. D. Stimpert, *Jour. Immunol.*, 40: 61, 1941.

with pooled CNS tissue from cotton rats of the first two passages developed characteristic flaccid paralysis; so did one of two monkeys injected with mouse brain from the fourth mouse passage.

The disease in mice and cotton rats was characterized by flaccid paralysis of fore- and hind-limbs with rapidly progressing muscular atrophy. In some, death occurred overnight, before paralysis was observed. The incubation period ranged from 4 days to 3 weeks; occasionally to 40 to 57 days. Infected mouse brain, diluted 1/1000, was infective for mice. In these characteristics and in its nonpathogenicity in adult mice by peripheral routes, and also in regard to the type of lesion produced in the CNS of mice and cotton rats, the agent is indistinguishable from the Lansing strain of poliomyelitis virus.[5] Its pathogenicity appears to be quite different from that described by Jungeblut and Sanders[6] for their rodent-adapted SK-strain. The relation to the cotton rat-acclimated poliomyelitis strains of Toomey and Takacs[7] is uncertain.

Identification by neutralization tests: Mixtures of serum and varying dilutions of Lansing virus- or Strain MEF1-infected mouse brains were incubated for 1 or 2 hours at room temperature or 37° C. and injected intracerebrally into mice (Rockefeller Institute strain). The results, as summarized in Table 1, indicate cross-neutralization between the MEF1 strain (before and after cotton rat and mouse passage) and Lansing virus. The MEF1 strain was also inactivated by MV-Philadelphia poliomyelitis monkey antiserum. Theiler's (mouse encephalomyelitis) virus was not neutralized by Strain MEF1 monkey anti- serum. Serum from Strain MEF2-convalescent monkeys neutralized Strain MEF1 as well as Lansing virus.

TABLE 1

RESULT OF INTRACEREBRAL NEUTRALIZATION TESTS IN MICE

Animal	Source of serum: Convalescent after infection with	Virus (infected mouse brain): MEF1	Lansing
Rhesus monkeys	MEF1—Monkey CNS	+	+
	MEF1 + 2—Monkey CNS	+	+
	MEF2—Monkey CNS	+	+
	MEF6—Monkey CNS (Rh. No. 3710)	0	0
	MEF6—Monkey CNS (Rh. No. 3711)	N.T.	0
	MV—Philadelphia	+	N.T.
	MEF1—Mouse CNS	+	+
	Lansing—Cotton rat CNS*	+	+
Cotton rats (Pool)	MEF1 { Mouse CNS / Cotton rat CNS	+	N.T.
Mice (Pool)	MEF1 { Mouse CNS / Cotton rat CNS	+	N.T.

+ = Neutralization.
0 = No neutralization.
N.T. = Not tested.
* = Lansing antiserum supplied by Dr. Max Theiler.

Strain MEF6 failed to induce antibody against either Lansing or MEF1 virus. The simultaneous presence of at least two serologically unrelated poliomyelitis viruses in one epidemic area would limit the usefulness of the mouse neutralization test for an epidemiological study of human sera from convalescents and contacts. Nevertheless, a variety of human convalescent sera received from Major Van Rooyen have been tested against Lansing virus. The significance of the results would depend on the outcome of similar tests planned with sera from healthy individuals of the Middle East Forces.

Attempts to transfer virus from other cases into rodents are being made.

Summary: Three strains of poliomyelitis virus were isolated by monkey passage from cases occurring among the Middle East Forces of the British Army. One was indistinguishable from the Lansing strain since it was transmitted to rodents and was serologically identical. The second was also serologically of the Lansing type, but thus far transfer to rodents has failed. The third was apparently not related to the Lansing or the first strain and passage to rodents has been unsuccessful. Thus, two apparently unrelated poliomyelitis viruses were isolated from the same epidemic area.

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THE MECHANISM OF AUXIN ACTION

A NUMBER of studies on the relation of plant auxins to enzyme activity[1,2,3] have been carried out in this laboratory. It has been reported that the activity of certain dehydrogenases from *Avena* coleoptile tissue is not accelerated when synthetic auxins are added to the functioning enzyme systems. Commoner and Thimann[4] have reported stimulation by auxin of the total oxygen uptake of excised, living coleoptile segments. A different approach to the problem, though less direct than the first mentioned, has yielded promising results, and since the work has had to be discontinued, we are reporting preliminary findings now.

[5] C. Armstrong, *Pub. Health Rep.*, 54: 1719, 1939; *Pub. Health Rep.*, 54: 2302, 1939; R. D. Lillie and C. Armstrong, *Pub. Health Rep.*, 55: 718, 1940.

[6] C. W. Jungeblut and M. Sanders, *Jour. Exp. Med.*, 72: 407, 1940.

[7] J. A. Toomey and W. S. Takacs, *Proc. Soc. Exp. Biol. and Med.*, 45: 364, 1940; 46: 22; 319, 1941; 47: 123, 1941.

[1] J. Berger and G. S. Avery, Jr., *Am. Jour. Bot.*, 30: 290–297, 1943.

[2] Ibid., 30: 297–302, 1943.

[3] Ibid., in press.

[4] B. Commoner and K. V. Thimann, *Jour. Gen. Physiol.*, 24: 279–296, 1941.

Segments from 3-day-old *Avena* coleoptiles are aked in distilled water or in a 10 mg per liter indole-etic acid solution for 15 to 24 hours; cell-free en-me extracts are made from these segments, and the hydrogenase activities determined by methods al-ady described.[1, 3]

Of the four dehydrogenases tested, alcohol dehy-ogenase is outstanding in its increased activity. us, in a series of fourteen experiments in which nditions of detail were deliberately varied in an fort to discover the maximum auxin stimulation, arked acceleration of alcohol dehydrogenase activity as found in six, and definite increase in malic de-drogenase activity in four. Glutamic and *iso*citric hydrogenase activities were not increased in any of e tests; this fact is significant because it indicates at the marked stimulation of the alcohol enzyme is ecific, and not a reflection of general increased etabolic activity. The data in Table 1 are indicative the results obtained. The average increase in activ-y, in those experiments which yielded positive re-ults, was about 200 per cent. for the alcohol enzyme nd 150 per cent. for the malic enzyme.

TABLE 1

EFFECT OF INDOLEACETIC ACID ON DEHYDROGENASE ACTIVITY IN *Avena* COLEOPTILE EXTRACTS. THE COMPOSITION OF THE VARIOUS REACTION MIXTURES IS APPROXIMATELY THE OPTIMUM REPORTED IN PREVIOUS PAPERS FROM THIS LABORATORY[1, 2, 3]

Molar concentration of substrate	Substrate	pH	Decolorization time in minutes (Thunberg technique) Expt. 1 Water-soaked	Expt. 1 Soaked in indoleacetic acid, 10 mg/liter	Expt. 2 Water-soaked	Expt. 2 Soaked in indoleacetic acid, 10 mg/liter
0.05	Na-*l*-malate	7.8	4.3	4.5	11.0	7.0
0.10	Ethyl alcohol	7.8	34.5	13.0	23.5	12.0
0.03	Na-*l*(+) glutamate	6.8	17.0	19.0	12.5	12.5
0.003	Na citrate*	6.8	17.0	18.5	17.5	16.0

* The same result was obtained in other experiments when *iso*citric acid was used as substrate.

These findings are particularly interesting when considered along with some of those of Commoner and Thimann.[4] They report that low concentrations of iodoacetate inhibit completely the growth of *Avena* coleoptile segments, but depress the respiration by only 10 per cent. This small iodoacetate-sensitive respiration thus appears to be in control of growth. Of the four *Avena* dehydrogenases tested to date in this laboratory, only the alcohol dehydrogenase is highly sensitive to iodoacetate.[3] This suggests the possibility that the alcohol dehydrogenase activity is closely concerned with control of growth. The present finding that alcohol dehydrogenase activity is affected the most by auxin, is consistent with the suggested important role of this enzyme in growth.

It is also reported[4] that maximum auxin stimulation (of growth and respiration of *Avena* coleoptile segments) occurs when malate is added. The acceleration of malic dehydrogenase activity in extracts from segments soaked in auxin also points to a connection between auxin action and malate metabolism. This relationship, however, does not appear to be as intimate as that of auxin and the alcohol enzyme, as interpreted from the preliminary results reported in this study.

Commoner and Thimann are the first to report auxin stimulation of respiration. In view of the fact that other workers have been unable to demonstrate such stimulation, it is perhaps worthy of mention here that we have confirmed some of their[4] work. For example, small but reproducible stimulation in oxygen uptake (Warburg apparatus) has been observed when auxin is added to the sucrose solution in which *Avena* coleoptile segments are floated.

Various mechanisms of auxin action have been suggested in the past decade. Of these, it seems to us that the most likely role is that of enzyme activation. The stimulation of alcohol dehydrogenase activity upon auxin treatment of plant tissue is evidence in this direction.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW MICROTOME AND SECTIONING METHOD FOR ELECTRON MICROSCOPY[1]

ONE of the principal limitations to the usefulness of the electron microscope is the extremely poor penetrating power of the electron beam. Although capable of very fine resolution, over one hundred times that of the light microscope, the electron microscope is limited in use to the examination of material that exists either as thin particles such as finely divided powdered crystals, etc., or to replicas in thin films of irregular surfaces. In the examination of solids, aside from the dispersion of the finely divided ones, no successful technique has been devised heretofore for the production of thin sections.

In the sectioning of biological materials such as tissues, a section thickness of ten microns may be satisfactory for light observation, but for penetration and

[1] We wish to acknowledge the helpful cooperation of the Buhl Foundation.

resolution of structural detail by the electron beam the thickness must be only one one-hundredth as great, or about 0.1 micron. Such a section thickness would lead from gross tissue and cell structure into the realm of cellular elements. Unless such a thin section is produced, the electron beam furnishes us only with silhouette images. Those images may be large and striking but are of limited value.

It has been obvious since the invention of the electron microscope that new methods of histological and cytological techniques must be discovered. With the finest of modern microtomes, it is possible to procure sections of biological material of approximately one micron in thickness. Such sections are produced only with great difficulty, and are ten times too thick to be used in electron microscopy. Some success has attended the production of thinner sections by the so-called wedge technique. The difficulties and irregularities accompanying this technique have been almost insurmountable.

To overcome these difficulties and in order to produce uniformly thin sections suitable for electron microscopy, a new feeding arrangement and rotary knife has been developed. In this new microtome the specimen is constantly moved toward a rotary "Cyclone" knife revolving at 10,000 r.p.m., or faster, the edge describing a circumference of eight inches. At 12,500 r.p.m., the blade is traveling 100,000 inches per minute which is about 1,000 times as fast as ordinary microtome movement. The advantage of this speed is apparent when the inertia of the specimen is considered, since at high speeds, strain distribution is localized at the knife edge. Limited stress distribution at high speed more readily overcomes the shearing force of the material and, in effect, a thinner stress plane exists ahead of the knife edge. We may liken the effect here to that of a rifle bullet striking a plane of glass. Only a small hole is produced; the whole glass plane will not be broken. For a given force and work expended on the specimen block, its consequent deformations are minimized by the short period of knife contact. The contact period is of the order of only 0.0001 second.

In sectioning, the properties of the tissue or other material must be considered; plastic flow, hardness, coefficient of thermal expansion, etc. With high-speed cutting plastic flow does not occur. The thermal expansion effect when sections are made with this high-speed knife is negligible. In view of this, material may be sectioned *in toto* without embedding, or sectioned in softer media, or frozen to lesser degrees than in ordinary techniques.

The 0.1 micron sections cut with the high-speed knife fly out at a tangent and are dispersed in the air. They may be collected on collodion films or other films mounted on the usual electron microscope screens held near the knife.

The accompanying drawing and description will show something of the general nature of this instrument. Arrangement has been made to feed the specimen up to the knife by means of a micrometer feeding

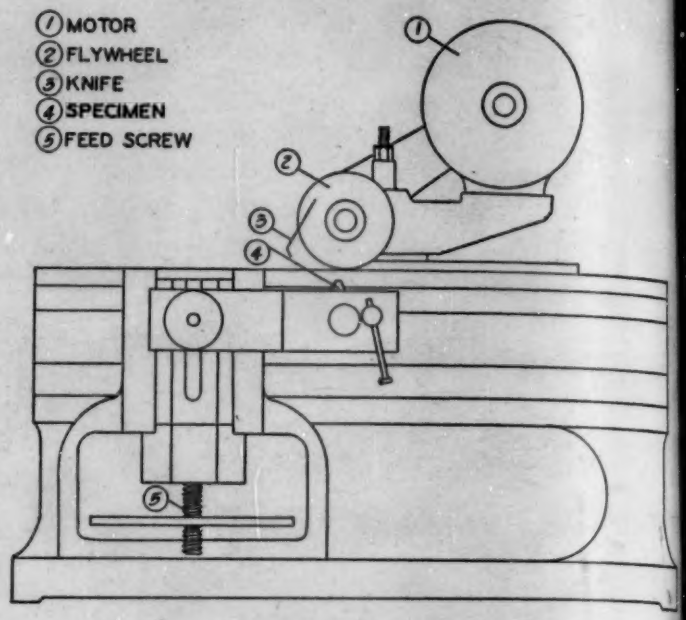

FIG. 1. The motor (1) as shown in the figure is a high-speed, 10,000 R.P.M., 1/14 horse power motor. A flywheel (2) of Duraluminum, $\frac{1}{2}'' \times 2''$, supported by a $\frac{1}{4}''$ shaft rotating on preloaded ball bearings and pulley-driven to revolve at 12,500 R.P.M. The edge of the knife (3) which is bent to decrease the cutting angle describes a circumference of 8 inches. A feed screw (5) has 50 threads per inch. When turned by the feed wheel at approximately 2.5 R.P.M., 0.1 micron sections may be cut from specimen (4).

mechanism. The knife is revolved by means of a motor which may be slid along the top of a sliding microtome block.

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